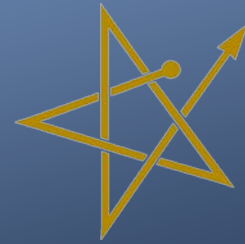


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NPRST-TR-13-1

December 2012

Suitability Screening Test for Marine Corps Air Traffic Controllers

Karen M. Walker, Ph.D.
William L. Farmer, Ph.D.
Rebecca C. Roberts, MS

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REPORT DOCUMENTATION PAGE			<i>Form Approved</i> OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.				
1. REPORT DATE (DD-MM-YYYY) 14 DEC 2012		2. REPORT TYPE Technical Report		3. DATES COVERED (From - To)
4. TITLE AND SUBTITLE Suitability Screening Test for Marine Corps Air Traffic Controllers Technical Report		5a. CONTRACT NUMBER		
		5b. GRANT NUMBER		
		5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) Karen M. Walker, PhD William L. Farmer, PhD Rebecca C. Roberts, MS		5d. PROJECT NUMBER		
		5e. TASK NUMBER		
		5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Navy Personnel Research, Studies, and Technology 5720 Integrity Drive BLDG 785 Millington, TN 38055-1000		8. PERFORMING ORGANIZATION REPORT NUMBER NPRST-TR-13-1		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Dr. Michael Bailey, Technical Director Operations Analysis Division, MCCDC 3300 Russell Road Quantico, VA 22134		10. SPONSOR/MONITOR'S ACRONYM(S)		
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION / AVAILABILITY STATEMENT Unlimited Distribution to include Operations Analysis Division (OAD) MCCDC				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT The objective of this study was to develop and validate the Marine Air Traffic Controller Suitability Test (MATC-ST), a non-cognitive profile of successful US Marine Corps Air Traffic Controllers (ATC), to assist in the selection and screening process of Marines for ATC duty. Through the use of the Navy Computerized Adaptive Personality Scales (NCAPS), non-cognitive traits were correlated with job advancement and qualifying performance measures, and used to develop the suitability profile of successful Marine ATCs. Hierarchical regression analyses suggest that the MATC-ST accounts for 14% of the variance of ATC job performance ($\beta=.375$, $t=5.804$, $p<.000$) and adds incremental validity above and beyond the ASVAB score in selection for the ATC Military Occupational Specialty (MOS). Making such a suitability profile greatly increases the efficiency of the Marine Corps ATC personnel pipeline and relieves the burden of unproductive training by providing early detection of Marines who are and are not likely to perform satisfactorily as ATCs. The implementation of the MATC-ST will reduce attrition and increase the quality of Marines selected for the ATC MOS.				
15. SUBJECT TERMS Non-Cognitive measurement, Air Traffic Control, NCAPS, NPRST, Marine Corps, Validation, Personality, suitability test, profiles				
16. SECURITY CLASSIFICATION OF: UNCLASSIFIED			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 36
a. REPORT	b. ABSTRACT	c. THIS PAGE		
				19a. NAME OF RESPONSIBLE PERSON Wendy Douglas
				19b. TELEPHONE NUMBER (include area code) 901.874.2218

Foreword

This effort was funded by the Operations Analysis Division (OAD) under program element HQMC AVN APX. The objective of this study was to develop a non-cognitive profile of successful US Marine Corps Air Traffic Controllers (ATC) to assist in the selection and screening process of Marines for ATC duty. Making such a suitability profile, known as the Marine Air Traffic Controller Suitability Test (MATC-ST), greatly increases the efficiency of the Marine Corps ATC personnel pipeline and relieves the burden of unproductive training by providing early detection of Marines who are and are not likely to perform satisfactorily as ATCs. A follow-up research effort will address a whole-Marine approach to selection by including cognitive standards in conjunction with the non-cognitive suitability profile developed herein.

The authors wish to thank the funding sponsor, and project officers for their assistance in this project. A number of subject matter experts at Marine Corps Air Traffic Control Facilities (ATCFs) provided invaluable assistance in the collection of questionnaire data, and their input greatly enhanced the development of the validation program undertaken in the present study.

D. M. CASHBAUGH
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Summary

Problem

Entry into military occupational specialty (MOS) training schools requires a minimum score requirement on the Armed Services Vocational Aptitude Battery (ASVAB), a test battery that assesses cognitive abilities through performance in reading, mathematics, general science, as well as basic knowledge about electronics, mechanical systems, and automotive-shop. The ASVAB was designed to increase the effectiveness and efficiency of the selection procedure, and determines that incumbents have the necessary cognitive skills to handle the technical aspects of training and job performance. However, the current Marine Corps Air Traffic Control selection process using the ASVAB has resulted in cognitively proficient applicants, who are, nevertheless, classified as “unsuited” for ATC duty during post-training performance. The inclusion of individuals into the ATC MOS who will ultimately be unfit for this position is an inefficient use of time and resources. The singular focus on cognitive skills has resulted in an unproductive and costly system, and requires an updated approach to screening and selection.

Objective or Purpose

Individuals possess a variety of abilities, preferences, interests, and personal characteristics that should be useful to predicting who will be best suited for different types of military jobs or duties. The objective of this project is to capitalize on these individual differences by developing a non-cognitive profile of successful air traffic controllers to be used in the selection procedures for Marine Corps ATC duty. Making such a suitability profile will greatly increase the efficiency of the Marine Corps ATC personnel pipeline and reduce the burden of unproductive training by providing early detection of Marines who are and are not likely to perform satisfactorily as ATCs.

Approach or Method

Using a multifaceted adaptive personality measure, the Navy Computer Adaptive Personality Scales (NCAPS), the authors assessed ATCs in the supporting establishment operating forces (7257, 7252, 7253, 7254 MOS) and Marine ATC students (7251 MOS) on 19 different individual traits. Through both concurrent and predictive validity designs, scores on the NCAPS were correlated with measures of ATC job and training performance. The resulting algorithm was used to create a profile from a subset of the NCAPS traits that demonstrates predictive validity for ATC performance. This profile of suitability for selection as an ATC was termed the Marine Air Traffic Controller - Suitability Test (MATC-ST).

Findings or Results

The subset of NCAPS traits that demonstrated statistically significant prediction for ATC (operating forces) performance and were included the Marine Air Traffic Controller

- Suitability Test algorithm were: Adaptability/Flexibility, Vigilance, Empathy, and Self-Reliance. Hierarchical regression analyses suggest that the non-cognitive suitability measure adds incremental validity above and beyond the ASVAB score, and accounts for 14% of the variance of ATC job performance ($R^2=.141$, $\beta=.375$, $t=5.804$, $p<.000$). Given a MATC-ST score, one can predict the expected level of success an individual Marine is likely to exhibit on the job and can make subsequently valid selection decisions.

Conclusions

The Marine ATC Suitability Test (MATC-ST) is a valid algorithm derived from the dimensions of NCAPS and has been shown to be predictive of success for Marine ATCs in the operating forces. Those with higher MATC-ST scores advanced and qualified at a faster rate than those with lower scores. The expectation is that the relationship will hold up for future ATC Marines and that a near term goal would be to evaluate the positive effects of an operational cutscore on the selection procedures. Further data collection and analysis at the ATC Schoolhouse will provide confirmation of the MATC-ST's predictive validity. If the MATC-ST is to be utilized for selection/classification it is recommended that it be used only in addition to the ASVAB, and implemented at the Military Entrance Processing Station (MEPS) prior to a Marine ATC MOS designation. This will reduce attrition/revocation and increase the quality of Marines selected for the ATC MOS.

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Introduction

The current Air Traffic Control selection process utilized by the US Marine Corps is being reviewed as a result of an unacceptable number of Marine Air Traffic Controllers (ATCs) being classified as “unsuited” for ATC duty as defined by performance and behavioral expectations. The first, most important step in creating a more efficient force is to improve the Air Traffic Controller (ATC) screening/selection process. This research effort focused on developing a non-cognitive Air Traffic Controller profile that could be incorporated into a model for their selection. Such a profile would allow the Marine Corps to identify those Marines who are likely to be successful as Air Traffic Controllers, those who need a greater depth of screening, and those who are likely to fail. This effort does not consider the Armed Services Vocational Aptitude Battery (ASVAB) standard that is established to minimize ATC academically related training failures. Another study that is being conducted as a follow-on to this research effort will address both the ASVAB standard in conjunction with the suitability screening test for this purpose and to replicate this study’s findings.

Background

To enlist in the military applicants must meet the minimum basic requirements on the Armed Services Vocational Aptitude Battery (ASVAB), a test battery that assesses performance in reading, mathematics, general science, as well as basic knowledge about electronics, mechanical systems, and automotive-shop. Marine Corps applicants who are recruited are evaluated on their ASVAB scores to identify a list of military occupational specialty (MOS) training schools they are qualified for, including ATC. Navy Personnel Research, Studies, and Technology (NPRST) has conducted two studies (Held & Johns, 2002; Held, 2006) addressing the establishment of optimal aptitude standards for the Navy’s Air Traffic Control A-School. The recommendations made by NPRST were put into operation for Navy recruits and have reduced academic attrition, while at the same time ensuring sufficient incoming class sizes.

Though cognitively based measures such as the ASVAB help to ensure that incumbents have the necessary information processing and problem solving skills to handle the technical aspects of training and job performance, other factors also contribute to success or failure in the occupation. Borman, et al., (2003) discussed in their review of selection and classification research that individuals are more complex and multidimensional than can be measured by the ASVAB alone. The ASVAB was designed to predict cognitive performance – particularly of performance through training. Beyond the cognitive abilities assessed by the ASVAB, however, individuals possess a variety of preferences, interests, and personal characteristics that should be useful for identifying who will be best suited for military missions of the future.

Many studies have found that measuring personality variables greatly enhances our ability to predict who will perform successfully across a variety of jobs in civilian and military settings. For instance, conscientiousness is one of the best predictors of

performance across a variety of jobs. By adding a measure of conscientiousness, an additional 18% of variation in on-the-job performance can be explained, over and above cognitive ability alone. Another important personality trait that accounts for an additional 10% of variance in performance is emotional stability. In fact, an investigation with military participants found that measuring emotional stability accounted for an additional 38% increase in incremental validity (see Ferstl, Schneider, Hedge, Houston, Borman, & Farmer, 2003). The established literature further demonstrates that personality traits can predict training performance.

NPRST has developed and utilizes the Navy Computer Adaptive Personality Scales (NCAPS), a multifaceted personality/character instrument for selection and classification. Items are presented in a paired-comparison format, and responders are required to choose the item in the pair that is most closely representative of them. This forced choice format has been shown to be more resistant to faking than other forms of response distortion (Jackson, Wroblewski, & Ashton, 2000).

NCAPS is an adaptive instrument, where item selection occurs through an algorithm that incrementally increases or decreases item difficulty according to the examinees' true ability. That is, if a participant responds correctly to an item, then he or she is presented with a more difficult item. Items are presented in this fashion until the participant consistently answers items correctly at a specific level of difficulty with the lowest possible (or acceptable) level of measurement error (Bartram, 1993).

In personality testing there is no correct or incorrect answer and "difficulty" does not take on the standard meaning as in an ability test. Instead a "difficult" item is one that is higher on the trait of interest (e.g., on a measure of extraversion, "I like parties" would be considered a higher level of a trait whereas "I like libraries" would be considered a lower level of a trait). As the respondent proceeds through the test, choosing an item that is higher on the trait being measured will cause the next pair of items to be representative of slightly higher levels of that trait. Items are presented in this fashion until the participant consistently endorses items at a specific level of the trait.

The purpose of computer-adaptive testing is to present items that are informative about the test taker and to maximize the precision of measurement in a limited amount of testing time. For example, on the traditional paper and pencil version of a cognitive ability test, a high ability person will receive the same easy items as everyone else, yet the easy items will contribute little to no information about the person's actual ability. By using an adaptive format, the high ability person will not be administered the easy items, as it is expected they are likely to be able to answer these correctly. By only administering items that are informative of the person's ability, the number of test items can be greatly reduced along with the administration time (Wainer & Mislevy, 2000). A similar approach is taken when measuring a person's personality trait level using NCAPS. An individual who consistently endorses items high on a particular trait domain will not be presented with items on the very low end of that trait scale; as they are likely to simply choose the other option, without adding information to their overall score on the domain.

Solely owned by the Department of the Navy, NCAPS gained recognition in 2010 from the Society for Industrial and Organizational Psychology, for technological innovation of applied psychology in the workplace. NCAPS has been found to be a valid

predictor of on-the-job performance and is highly resistant to faking (Houston et. al., 2006; Underhill et. al., 2008). NPRST is currently conducting NCAPS validation studies for many Navy jobs and developing tailored selection systems. For example, a subset of NCAPS is part of a comprehensive selection system for the Navy Special Operations (SEAL) community. NCAPS selection system development work is also currently ongoing for other Navy special operations groups (i.e., EOD, Navy Divers, SWCC, and AIRR) as well as with Navy recruiters.

This research with the Marine Corps ATC community expanded opportunities to develop a comprehensive selection system for Marine ATCs that includes a tailored NCAPS that goes beyond predicting just training outcomes. As a starting point, Dibble (2007) identified ATC relevant non-cognitive traits from subject matter experts. These traits include professionalism, working cooperatively, personal tolerance, work/effort, self-esteem, aggressiveness, attention to detail, task closure/thoroughness, decisiveness, consistency, flexibility, concentration, composure, tolerance for high intensity work situations, and commitment to the job. Many of these traits are embodied in the NCAPS and a composite of NCAPS facets recently developed to measure a constellation of vigilance and diligence has demonstrated validity for predicting job performance for a number of Navy ratings. Therefore, NPRST is uniquely qualified to execute research necessary to build an Air Traffic Controller selection system for the Marine Corps.

This research project addressed the studies and technology element:

- What individual characteristics will predict success in the Marine Corps ATC military occupational specialty (MOS) operating forces assignments?

Method

In personnel selection and classification it is customary to develop measures that predict job performance and/or job tenure. Measures given to job applicants need to assess the knowledge, skills, and abilities necessary for successful performance in a particular job, ideally without producing adverse impact (large mean differences) for racial, ethnic, or gender groups. This study relied on a mix of predictive and concurrent validity designs using NCAPS and Marine ATC performance measures. A concurrent validity design is when the predictor is administered to participants close in time to when the criterion (performance measure) is collected (e.g., on the job). NCAPS was administered in such a concurrent validity design. A predictive validity design is when the predictor is administered long in advance to all applicants who have yet to be selected for the job, and thus represents a more realistic setting in which the instrument will ultimately be used. The ASVAB, to be compared with NCAPS, was administered in a predictive validity design.

The validation approach chosen for this project was a criterion-related strategy. This is traditionally accomplished by obtaining the test scores of job applicants as predictors and then collecting measures of these same individuals' job performance, the criterion (or criteria if more than one type of measure is collected). The predictor test scores are then related statistically to how well individuals perform on the job and, if successful, can be used to identify the most qualified candidates for the position by predicting how

individuals with particular test scores will likely perform. This validation methodology is one of three validation strategies presented in the *Uniform Guidelines on Employee Selection Procedures* (1978, EEOC), the *Standards for Educational and Psychological Testing*, and the Society for Industrial/ Organizational Psychology's (SIOP) *Principles for the Validation and Use of Personnel Selection Procedures* (1987).

In order to statistically perform this validation, measurements of job performance and NCAPS scores were provided for Marines currently training at all stages of the pipeline (both concurrent and predictive data). This included Marine ATCs in the operating forces as well as any new Marine ATC arrivals at the ATC Schoolhouse.

Data Collection

Data were collected from Marine ATC students (7251 MOS) at the Air Traffic Controller Schoolhouse in Pensacola, Florida and from Marine ATCs (7257, 7252, 7254 MOS) at eight different Marine Corps Air Station Air Traffic Control Facilities (MCAS ATCFs). Data collection consisted of interviews, observations, performance measurements, and NCAPS scores.

ATC Schoolhouse

The 14-week school consists of three blocks of training that have knowledge based written tests and performance based assessments. Block One training is six weeks long, entirely knowledge based, and concludes with the FAA qualification written exam. Block Two consists of local control, ground control, and flight data performance based assessments. Block Three consists of basic radar, ASR, PAR, and Arrival written tests and performance based assessments.

The schoolhouse requires a 70% or higher grade to pass, however in the operating forces an 80% or higher is required to receive qualifications. ATC officials view ATC school as preliminary and expect that more extensive learning occurs with On-the-Job-Training (OJT), the platform MOS, and other required operating force qualifications to maintain qualified controller status.

Schoolhouse Instructor/Staff Interviews

NPRST researchers met with school officials to discuss the study objectives and methods, and the aptitude strengths and weaknesses of incoming trainees. Researchers were given tours of the classrooms; the tower simulator and other computer based classroom training, and allowed individual time to interview key instructors in this process. Arrangements were also made for collection of performance measures for students.

- Marine Corps uses an ASVAB GT (VE, Verbal + AR, Arithmetic Reasoning + MC, Mechanical Comprehension) score of 110 as a minimum qualifier. A Marine recruit is then designated into Aviation and disseminated between ATC, Weather, and UAV. Instructors also confirmed that this process leads to motivational

concerns as to whether Marines selected for ATC School have the motivation to be there.

- According to instructor/Staff interviews, trends were reported in higher Block One student failures of the: General Tower, ATC Terminal Procedures, and Emergency/Non-Radar Exams; higher Block Two student failures of the Local Control Exam; and no trends reported for Block Three student failures.
- For performance based evolutions (Blocks Two and Three) students are evaluated with critique sheets that are filled out for each evolution that include instructor comments. The Critique/Evaluation sheets are based on the position being evaluated (Local Control, Arrival, etc.) and students are given three scores: (S) satisfactory, (N) needs improvement, (U) unsatisfactory. Instructors give recommendations for improvement on these critique sheets. A student's performance folder is collected upon graduation/drop and destroyed after two years.

Other comments concerning motivation for Marine 7251s from instructors and staff were:

- The instructors commented on attributes besides intelligence that make successful 7251s. Some mentioned skills like *multitasking*, such as "being a bartender", is comparable to being an ATC. Others commented that skills like *achievement motivation* and *perseverance* count the most in getting through the ATC School successfully.
- "Students don't fear authority."
- "They don't see a problem with quitting. If I put a bell on the quarterdeck, they would ring it here!"
- "They don't see a problem with failing. They treat it like a video game. They make a mistake and they want to push reset and start over."
- Remediation and re-test is guaranteed to students who have failed an exam. Instructors noted that those students that reach out for help, use labs outside of class time and that ask questions, or take initiatives to approach instructors after class are the most successful at successfully completing ATC School.

Schoolhouse Performance Measures

In order to measure performance at the ATC schoolhouse we collected Grade Point Averages (GPA) for each Marine student at each block of training. In the context of this report, GPA is a composite score consisting of the mean average for each block of training. GPAs were collected at the end of Block 1, Block 2, and Block 3 for each Marine ATC student (7251).

NCAPS at Schoolhouse

The Navy Computer Adaptive Personality Scales (NCAPS) is a web-based non-cognitive measurement tool consisting of 19 dimensions. NCAPS was administered to incoming and current 7251s.

MCAS ATC Facilities

After reviewing the existing job analysis information, sites visits were conducted to observe controllers from the various MCASs. The primary purpose of these initial site visits was to gain a better understanding of the ATC job, the on-the-job training at each of the MCASs, and to speak with SMEs and supervisors about the training process. Observations were made of the controllers from various radar and tower positions performing their job, and researchers discussed the various components of the job and training process with the controllers, their trainers, and supervisors. In some cases, supervisors identified high and low performers within their teams and described qualities or abilities necessary for high performing ATC Marines.

When a 7251 arrives to a MCAS ATC Facility (ATCF) they endure an indoctrination process that consists of an assignment to an On-the-job Instructor (OJTI), testing, and orientation syllabus. Each MCAS ATCF has an indoctrination process to help a 7251 understand the process to 7257 qualification at that particular ATCF. Each MCAS ATCF also has permanent qualified civilian ATCs as training specialists to ensure continuity.

Instructor/Staff Interviews by MCAS ATCF

Site visits, observations and interviews were conducted with seven out of nine MCAS ATCFs. However, due to proximity and time restrictions instructor/staff interviews and site visits were not conducted at: *MCAS Iwakuni, Japan*, and *MCAS Futenma, Japan*.

MCAS Beaufort, South Carolina

MCAS Beaufort ATCF handles military and civilian air traffic. They oversee 0-10,000 ft within their jurisdiction. Jacksonville Center handles flights 11k and above. Other major airfields include: Ridgeland to the West, Walterboro to the North, and Hilton Head to the South. Hilton Head airport is the busiest and handles upwards of 25,000 flights per year.

MCAS Beaufort ATCF has 13 civilian controllers that remain at the Facility for training continuity. The military members usually rotate every three years. This is standard practice for Marine ATCFs. MCAS Beaufort ATCF trains and qualifies 7257s, and 7253/7254s on a 24 hour three crew rotation. The training specialist has implemented a syllabus for training that has allowed a structured format for learning and adequate practice hours for each ATC Marine. According to the training specialist at MCAS Beaufort ATCF this formalized syllabus approach to training has increased productivity for Beaufort ATC and decreased time (months) to qualification. They regularly train ATC Marines on the AT Coach embedded system by Raytheon. They also utilize the Tower Simulator and recommend it for ATC Marines with less experience because it gives them significant practice hours with an Instructor.

MCAS Beaufort ATCF SMEs commented that trends in 7251 knowledge based deficiencies are in: phraseology, separation standards, and weather. SMEs for Beaufort ATCF also commented that the aeromedical screening needs to be more precise for 7251 selection, for instance vision issues, back problems, medications that affect alertness,

and mental depression, which can all lead to an ATC Marine being designated not physically qualified (or not aeronautically adaptable). Some other factors that Beaufort ATCF agreed on as successful attributes in ATCs performance are: ***adaptability, motivation to train and to learn, a 3D (third dimension) mentality, and abstract thinking ability.***

MCAS Cherry Point, North Carolina

MCAS Cherry Point ATCF handles military and civilian air traffic. They oversee airspace, 0-10,000 ft within their half of their jurisdiction and 0-18,000 ft in the other half. There are six restricted areas and one other Marine Corps Air Station (New River) within their airspace. Surrounding airways include: Coastal Carolina Regional Airport in New Bern (due north) and servicing Delta and US Airways as well as civil traffic; and Michael J. Smith Field in Morehead City (due south) which is an uncontrolled airport serving civil aircraft.

MCAS Cherry Point ATCF has 20 civilian controllers that remain at the Facility for training continuity. The military members usually rotate every three years. This is standard practice for Marine ATCFs. MCAS Cherry Point ATCF trains and qualifies 7257s, 7252s and 7253/7254s on a 24 hour three crew rotation.

The MCAS Cherry Point ATCF training specialist works closely with the OJTIs to match incoming 7251's with their crews. There is an indoctrination process at MCAS Cherry Point ATCF but they lean towards a "college approach" or a "more flexible testing" process when it comes to written exams. New 7251s are provided the materials but written exam scores are not kept on file. Skill Checks/Performance evaluations are maintained for 25%, 50%, 75% and 100% of training. The radar control room has the capability to use a Raytheon Star, aka the AT Coach. The Tower Simulator was available for required training hours, but was considered to be "inconvenient" and "unnecessary" given the amount of live air traffic routed through Cherry Point. According to the training specialist at MCAS Cherry Point ATCF average time to qualify 7257s at MCAS Cherry Point is four months.

MCAS Cherry Point ATCF SMEs agreed that there are some trends in ATC performance:

*"Some 7251's are really smart, but can't apply it (knowledge); They lack common sense or they **can't improvise.**"*

*"They **can't multitask** or have **problems thinking 3-dimensionally.**"*

*"Sometimes lateral movers qualify faster. It may be because of more seasoning (experience) and **self-confidence.**"*

MCAS New River, North Carolina

MCAS New River ATCF handles military and civilian air traffic. They are responsible for Class D (surface to and including 2500ft with 5nm radius around NCA) and Class E (700 to 3000 ft with a 7NM radius around NCA) airspace. Surrounding airports include: Albert Ellis (NW), MCALF Bogue Field (NE), Wilmington (SW), Kinston (N), and Cherry Point (NE).

MCAS New River has ten civilian controllers that remain at the Facility for training continuity. The military members usually rotate every three years. This is standard practice for Marine ATCFs. MCAS New River ATCF trains and qualifies 7257s, 7252s and 7253s utilizing a two crew rotation.

The MCAS New River ATCF Training and Standardization Officer works closely with the Non-Commissioned Officer-in-Charge when assigning 7251s to a crew. Their indoctrination process includes a syllabus with five knowledge based exams. During this visit the Tower Simulator was in need of repair. MCAS New River relies on a rigid exam process that requires memorization of phraseology and four tests per ATC position. Training consists of daily evaluations, simulations and skill checks.

MCAS New River ATCF SMEs agreed that there are some trends in ATC performance:

*“There is a **lack of desire and motivation** (in some 7251s). They **don’t have that drive** to do the work **or the motivation** to prepare for continuous evaluations..It can be a safety issue, when they (7251s) lack the motivation to be here or express that they ‘didn’t want this job’.”*

Sometimes a lack of motivation is expressed with “an **‘I don’t care if I fail** (as an ATC), because I will still get promoted and I still get paid (as a Marine)’ attitude.”

*“It is **important to be able to think on your feet**. They need to be able to **communicate**. **Introverts may have a hard time** with this job.”*

MCAS Quantico, Virginia

MCAS Quantico ATCF handles military and civilian air traffic. They are responsible for 0-3000ft. Surrounding airports include: Stafford (SW), Andrews, Dulles, Reagan (N), and Richmond (S). They are also responsible for a Special Flight Restriction Area (SFRA) over the Capital that requires unique clearing procedures.

MCAS Quantico has three civilian controllers that remain at the Facility for training continuity. The military members usually rotate every three years. This is standard practice for Marine ATCFs. MCAS Quantico trains and qualifies 7257s, 7252s and 7253s utilizing a two crew rotation.

The MCAS Quantico ATCF Training Chief works closely with the OJTIs when assigning 7251s to a crew. Their indoctrination process includes a syllabus with knowledge based exams. They rely heavily on the Tower Simulator due to very low air traffic in/out of Quantico. Training also consists of daily evaluations, simulations and skill checks.

MCAS Quantico ATCF SMEs agreed that there are some trends in ATC performance:

*“7251s without prior experience can be ‘lost in the sauce’ and **lack maturity and common sense**.”*

*Staff recommended that **7251s should not be sent to Quantico** due to a low volume of air traffic. “A weak Quantico controller is a revocation somewhere else.”*

*“They need some natural abilities, like **aggressiveness**. They need to be **assertive on position**. Shy, quiet people will struggle in this job.”*

*“**Confident** controllers know that they can do the job. If a controller is unsure of themselves then they can’t do the job.”*

MCAS Yuma, Arizona

MCAS Yuma ATCF's airspace is rectangular and approximately 90 miles by 70 miles from surface – 23,000 ft. There are multiple restricted areas, and Special Use Airspace (Ranges), which are included within the airspace. Yuma ATCF handles every type, model, and series of aircraft (commercial, private, and military) and unmanned aerial systems as well. Adjacent airports include: NAF El Centro (W), Imperial (W), Luke AFB (NE), and Laguna AAF (N). Yuma ATCF is the only Joint (Military/Civilian) MCAS, and also the DoD's only Enroute RADAR Facility, as such they coordinate with both Los Angeles Center and Albuquerque Center.

MCAS Yuma has 28 civilian controllers that remain at the Facility for training continuity. The military members usually rotate every three years. This is standard practice for Marine ATCFs. MCAS Yuma ATCF trains and qualifies 7257s, 7252s and 7253/7254s, operating for 24 hours on a three crew rotation.

The MCAS Yuma ATCF training specialist works closely with the Training Chief when assigning 7251s to a crew. Their indoctrination process includes orientation and academic training with their Primary Position Instructor (PPI). Training consists of daily simulations, familiarization time, and skill checks.

MCAS Yuma ATCF SMEs agreed that there are some trends in ATC performance:

*“There is a **different mindset** (from 7251s) out of the schoolhouse. It used to be a privilege to make it out (of school) because a lot of Marines didn’t make it. We actually feared failure. Now there is **no sense of competition or incentives** to be the best.”*

*“The **successful 7251s** I see are **quick thinkers**- they can **think on their feet**. If I ask them a question and they hesitate or can’t answer then that’s not good. Also good (air traffic) controllers have **confidence** and are **sure of themselves**. If they are **too quiet, talk low, or afraid to voice their opinion** then they **will probably not make it**.”*

*“**Over thinkers have a hard time** in this field- ‘paralysis by over analysis’.”*

*“The **best controllers** have **awareness and multitasking** ability. They take some **personal initiative** to study at home or seek out their PPI instead of waiting to be told what to do next.”*

MCAS Camp Pendleton, California

MCAS Camp Pendleton ATCF primarily handles military air traffic in and out of MCAS Pendleton. They also control instrument arrivals/departures into and out of one satellite airport, Fallbrook Airpark, which is located approximately 7NM Northeast of MCAS Camp Pendleton. They oversee a 17 by 7 mile area that contains two sections: Area A and Area B. Area A is a small area overlying the Camp Pendleton airport and

extends to the southwest approximately five miles. They are responsible for surface to 3000 ft in this area. Area B is the larger area that extends northeast toward the Temecula Valley. They are responsible for surface to 5000 feet in this area.

MCAS Camp Pendleton has nine civilian controllers that remain at the facility for training continuity. The military members usually rotate every three years. This is standard practice for Marine ATCFs. MCAS Camp Pendleton ATCF trains and qualifies 7257s, 7252s and 7253s, utilizing a two crew rotation.

The MCAS Camp Pendleton ATCF Training and Standardization Officer works closely with the Tower and Radar Training Chiefs, and Crew Officers/Chiefs when assigning 7251s to a crew. Their indoctrination process includes orientation and academic training with their OJTIs. After assigned to a crew, they utilize the AT Coach, IPART, PAR and Tower Simulator. Training consists of daily simulations, evaluations, and skill checks.

MCAS Camp Pendleton ATCF SMEs agreed that there are some trends in ATC performance:

“Lateral movers do very well. Their maturity levels, Marine leadership and experience is an asset.”

“Great controllers use **personal initiative** and have a **natural aggressiveness**.”

“Sometimes the **new 7251s are too timid and hesitant to talk** to others. That shows and it hurts them (their performance) if they are hesitant to talk to aircraft.”

MCAS Miramar, California

MCAS Miramar ATCF primarily handles military air traffic. They are located in San Diego just north of Montgomery Field. They provide ATC Tower and GCA services North of Highway 52, within Class B airspace from 4 miles to the Northeast, surface to and including 3000 ft.

MCAS Miramar has eight civilian controllers that remain at the Facility for training continuity. The military members usually rotate every three years. This is standard practice for Marine ATCFs. MCAS Miramar ATCF trains and qualifies 7257s, and 7252s utilizing a two crew rotation. The MCAS Miramar ATCF Branch and Training Chiefs work closely with crew leadership personnel and OJTIs when assigning 7251s to a crew. Their indoctrination process includes orientation and academic testing.

MCAS Miramar ATCF SMEs agreed that there are some trends in ATC performance:

“To be successful you need an ‘**A-type**’ **personality**. Don’t settle for second best and **always wanting to do better**. This type of attitude puts 7251s farther ahead.”

“They have to have **good study habits** and **time management**. They have to retain a lot of information but also **be able to apply it**.”

Operating Forces Performance Measures

Performance measures were collected from nine MCAS ATCFs. The performance measures consisted of:

- GT Scores (VE/AR/MC)
- Start Date of 7257 training
- 7257 Qualification date
- 7257 written exam scores/GPA
- Start Date of 7252 training
- 7252 Qualification date
- 7252 written exam scores/GPA
- Start Date of 7253/54 training
- 7253/54 Qualification date
- 7253/54 written exam scores/GPA

NCAPS in Operating Forces

NCAPS was administered to 7251s, 7257s, 7252s, and 7253/54s, currently in the operating forces at nine different MCAS ATCFs. The nine MCAS ATCFs were: MCAS Beaufort, SC; MCAS Cherry Point, NC; MCAS New River, NC; MCAS Quantico, VA; MCAS Yuma, AZ; MCAS Camp Pendleton, CA; MCAS Miramar, CA; MCAS Futenma, and MCAS Iwakuni, Japan.

Validity Analysis

Validity refers to the correlation between a predictor of success (such as the ASVAB GT Score, or NCAPS) and an objective performance measure (such as school grades or graduation status, or time to 7257 qualification). The ASVAB (GT Score) has demonstrated validity for predicting job performance, but is most predictive of academic performance. NCAPS has demonstrated validity for predicting job performance. The correlation between the two predictors is dependent upon the constructs being measured by the specific criterion.

Performance Measures

Job performance is a multifaceted construct that can be measured in a variety of ways (peer ratings, supervisor ratings, customer ratings, output, qualifications, absence of errors, etc.). For the present study, a variety of proxies for job performance were considered, but the following provided the most significant results.

Schoolhouse performance measures

GPA scores for Block One, Block Two, and Block Three were collected and standardized. ASVAB (GT Scores) were also collected.

Operating Forces performance measures

While some Marines are able to master the position and pass the qualification exams within a few months, others take much longer. Marines who are able to meet qualification at a quicker pace are often considered better performers and more proficient controllers. Therefore, time to qualify may be considered a proxy for job performance, in that these individuals are more naturally suited to the demands of ATC positions, and thus require less time to exhibit proficient performance.

Time to qualify was calculated from training start date to qualification date for 7257, 7252, and 7253/54 and was standardized across ATCFs. Each ATCF provides a unique training opportunity for the Marines stationed there; and as a result, Marines training at different bases are exposed to overlapping, but not quite parallel training opportunities. For example, a station that controls a complex air space that can facilitate a variety of aircraft operations may provide opportunity for Marines to train on a range of real-world scenarios. Meanwhile, Marines at bases with less traffic and less complexity in airspace are not exposed to these challenges as readily or consistently. This variability in exposure is likely to facilitate training on some bases, and allow Marines to more quickly qualify on their positions. Given this set of circumstances, standardization was necessary for time to qualify across ATCFs, such that those who quickly qualify at their respective stations will be acknowledged as high performing trainees.

There was considerable variability among each ATCF; therefore a standardization technique was used to place performance scores by ATCF on a common scale. For example, a high performer at Cherry Point ATCF may qualify in four months whereas a high performer at Yuma ATCF may qualify in six months. In this case, standardized scores per ATCF will recognize high performers across various units and not differentiate them when site factors, not personnel attributes or ability, account for the time differentials.

Qualification test scores (written exam and performance exam) were collected and averaged for a GPA for 7257, 7252, and 7253/54. The GPAs were also standardized by ATCF. ASVAB (GT Scores) were also collected.

Results

The resulting data from the ATC facilities were cleaned and subjected to various analyses including validity analysis. Data for the schoolhouse is still being collected and so results are not yet available. This section describes the data obtained and analyses with the results reported up front. Validity analysis determined:

- NCAPS scores are a valid predictor of success for Marine Air Traffic Controllers in the Operating Forces. Success in the operating forces is determined by time to 7257 qualification.
- ASVAB GT Scores did not correlate significantly with performance for the operating forces as did NCAPS measures.
- Regression analyses clearly indicate that non-cognitive measures, especially those assessed with the Marine Air Traffic Control Suitability Test (MATC-ST), add incremental validity above the ASVAB GT Score.

Background and demographics

This section describes the sample of participants who took part in the study, as well as the characteristics of the performance measures collected from those participants. Table 1.1 presents background and demographic information for 208 Marine Corps ATC operating force (7257, 7252, 7253/54) participants. The majority of the sample was male (92.3%), White (63%), with less than four years of service (70.5%). Most of the sample was between Lance Corporal (LCpl; E3 paygrade) and Sergeant (Sgt; E5 paygrade), (88%).

Table 1
Operating Forces Demographics

		Frequency	Percent	Cumulative Percent
Gender	Male	192	92.3	92.3
	Female	16	7.7	100.0
Ethnicity	White	131	63.0	63.0
	Hispanic	33	15.9	78.9
	Black	14	6.7	85.6
	Asian or Pacific Islander	10	4.8	90.9
	American Indian	3	1.4	92.3
	Other	16	7.7	100.0
Rank	E2 (PFC)	3	1.4	1.9
	E3 (LCPL)	44	21.2	23.1
	E4 (CPL)	81	38.9	62.0
	E5 (SGT)	58	27.9	89.9
	E6 (SSGT)	19	9.1	99.0
	E7 (GYSGT)	2	1.0	100.0
YoS	>4	146	70.2	70.5
	5-9	53	25.5	96.1
	<10	8	3.8	100.0
Unit	Beaufort	20	9.6	9.6
	Cherry Point	46	22.1	31.7
	Camp Pendleton	39	18.8	50.5
	Futenma	4	1.9	52.4
	Iwakuni	4	1.9	54.3
	Miramar	20	9.6	63.9
	New River	27	13.0	76.9
	Quantico	28	13.5	90.4

NCAPS Data Summary

At the time of this report, complete data were obtained from the NCAPS measure for 130 Marine Corps ATC Schoolhouse (7251 MOS) participants and 847 Marine Corps ATC operating force (7257, 7252, 7253/54) participants.

Of the 19 NCAPS components, four were related to attributes relevant to the current research effort. . For each NCAPS component, the data consist of a theta value that describes the participants standing on the construct being measured, and a PSD or posterior standard deviation, which is an index of algorithm convergence. A theta value is defined as an individual's standing on a construct being measured using adaptive testing, or item response theory, where items are presented to individuals based on their

responses to prior items. This process continues until the algorithm closes in on that individual's standing on the construct, which is represented by the value of theta.

The four relevant NCAPS dimensions for ATC operating forces performance were: Adaptability/Flexibility (+), Vigilance (+), Empathy (-), and Self-Reliance (-). The degree of relevance, or relatedness (validity) was derived through regression analyses, which identified these four dimensions (or traits) as statistically significant predictors of ATC performance in the operating forces. (Regression analysis was not conducted on the ATC schoolhouse data at the time of this report because, as mentioned earlier, schoolhouse data collection is still in progress). These NCAPS dimensions were used to develop the algorithm for the Marine Air Traffic Control Suitability Test (MATC-ST).

Operating Forces Performance Data Summary

The ATC operating forces performance data summary in Table 2.1 includes the minimums, maximums, means, modes, and standard deviations of GT Score, 7257 GPA, and 7257 performance score (standardized days to 7257 qualification). GT Scores were collected for 187 ATC operating forces Marines, with a minimum GT Score of 102, a maximum GT Score of 142, a mean GT Score of 115.71, the mode GT Score was 114, and the standard deviation for GT Score was 8.268.

The 7257 GPA was collected for 122 ATC operating forces Marines, with a minimum GPA of 83%, a maximum GPA of 100%, a mean GPA of 93.22%, the mode GPA was 94% and the standard deviation for GPA was 4.10%. The performance score (standardized days to 7257 qualification) was collected for 208 Marines, with a minimum performance score of (-3.12), a maximum performance score of 1.96, a mean performance score of .0024. The standard deviation for performance score was .98727.

Table 2
Operating Forces Performance Descriptive Statistics

	N	Minimum	Maximum	Mean	Mode	Std. Deviation
GT Score	187	102	142	115.71	114	8.268
GPA 7257	122	83	100	93.22	94	4.100
Performance Score	208	-3.12	1.96	.0024		.98727

Marine ATC Suitability Test Score and Validity Analysis

The Marine ATC Suitability Test (MATC-ST) score is calculated from four dimensions of NCAPS that were submitted in regression analysis with the operating forces Performance score as the performance criterion. This section describes the correlation and regression analyses.

Table 2.2 presents the intercorrelations of the predictor test scores, (MATC-ST), ASVAB GT, and the criterion, operating forces performance scores.

Table 3
Predictor Test Scores and Performance Score Intercorrelations

	Suitability Score	Performance Score	GT Score	GPA7257
MATC- Suitability Test Score	1			
Performance Score	.375**	1		
GT Score	-.006	.077	1	
GPA7257	.030	.110	.064	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 2.2 shows that the only correlation that was statistically significant was between the MATC-Suitability and the Performance score, ($R = .375$, $p < .01$). For completeness, the data were used in a hierarchical regression.

Through hierarchical regression, the prediction of the MATC-ST score on performance outcomes may be isolated and compared to the prediction of other factors, such as the ASVAB score, as well as the prediction of composites of multiple factors at once. This technique uses comparisons of successive regression models and determines the significance that each one has above and beyond the others. Three models were tested and compared: (1) the ASVAB GT scores' prediction of Performance scores, (2) the MATC- Suitability Test scores' prediction of performance scores, and (3) regression weighted composite scores' (made up of ASVAB GT and MATC-Suitability) of Performance scores.

The Marines currently use the ASVAB as a selection screening tool to gain access to the ATC School; therefore, GT Score was the first variable entered (model 1), followed by the MATC-Suitability Test score (model 2), and the resulting composite (model 3). Results of the regression analysis are presented in Table 2.3 (weights are standardized beta (β) weights and thus represent correlations).

Table 4
ATC Operating Forces Hierarchical Regression Validity Analysis

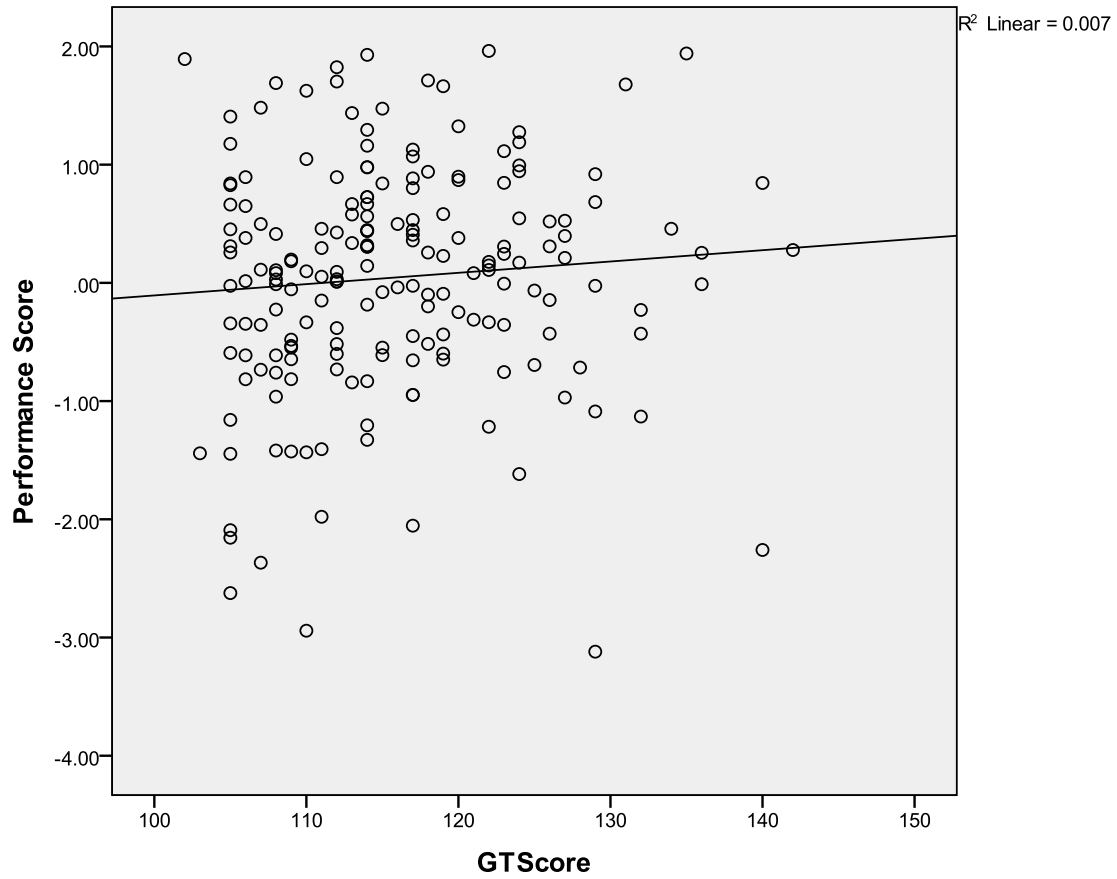
Measure	Standardized Regression Coefficient	t	Probability of Sig.
GT Score	.082	1.127	.261
MATC Suitability Score	.375	5.804	.000*
GT Score + MATC Suitability	.371	5.304	.000*

a. Dependent Variable: Performance Score; *Statistically significant at the $p < .001$ probability level.

Table 2.3 results showed that, as expected from the results in table 2.2, GT Score alone (model 1) does not predict Performance Score at a statistically significant level (model 1; $\beta = .082$, $t = 1.127$, $p < .261$). However, when the MATC-Suitability was added into the next step (Step 2) of the hierarchical regression analysis, the results were statistically significant (model 2; $\beta = .375$, $t = 5.804$, $p < .000$). The .082 standardized regression weight for GT and .375 for MATC-Suitability are the exact correlations reported in Table 2.2, just confirming in regression analysis that two variables do not overlap and that adding MATC-Suitability to the operational GT selection system adds unique variance accountability.

As expected from Table 2.2's statistically non-significant $-.006$ correlation between MATC-Suitability and GT, a composite of the two variables entered in the third model (Step 3) did not improve the prediction over MATC-Suitability alone. (Model 3; $\beta = .371$, $t = 5.304$, $p < .000$). That is, the model was only significant due to the fact that MATC Suitability Test Score has a significant predictive relationship to Performance Score (again, model 2; $\beta = .375$, $t = 5.804$, $p < .000$).

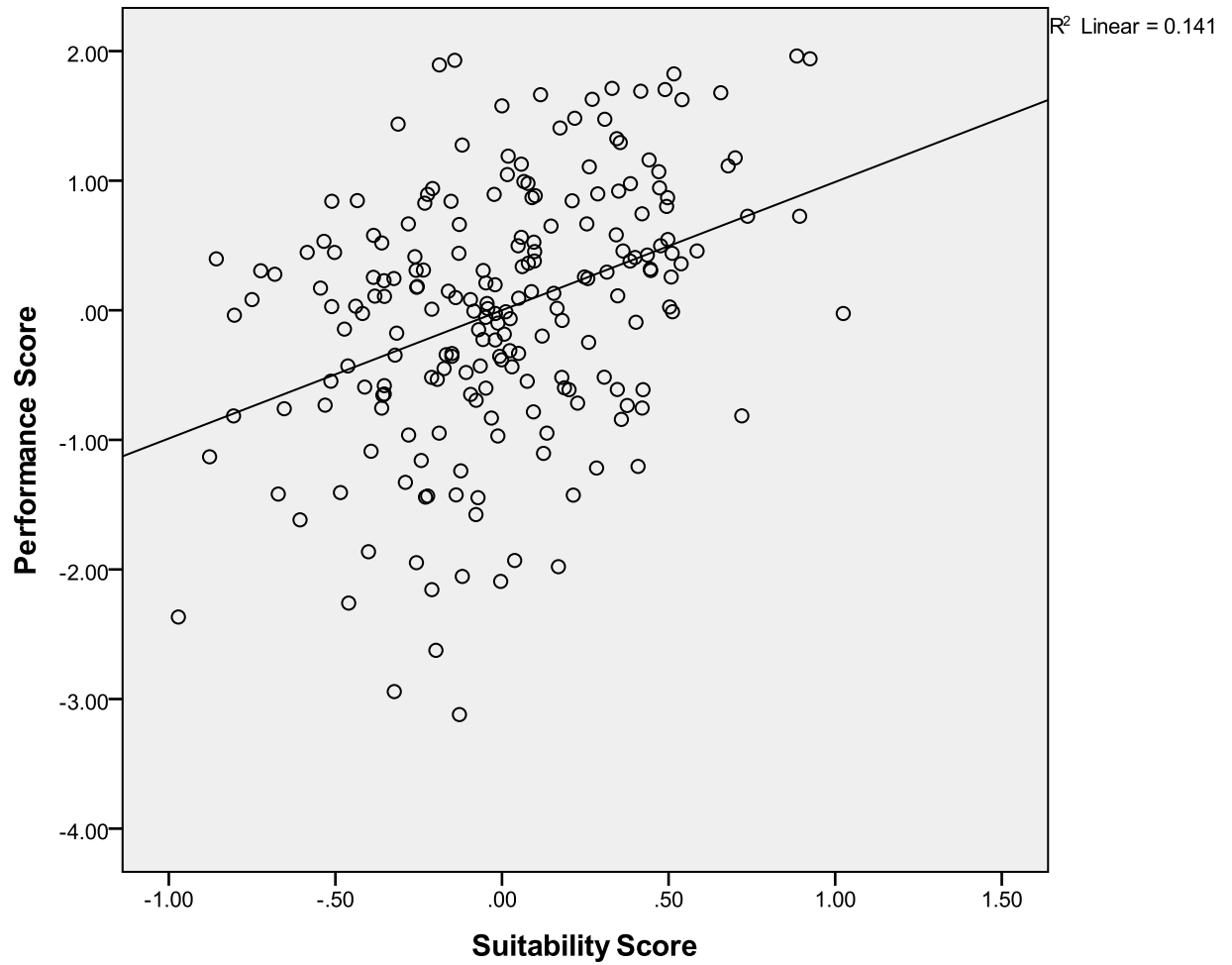
Figure 1.1 provides a graphical representation of the predictive relationship between GT Score and Performance Score ($R^2 = .007$). Figure 1.2 provides a graphical representation of the predictive relationship between MATC Suitability Test score and Performance Score ($R^2 = .141$). Finally, Figure 1.3 applies to the combined GT and MATC-Suitability as the predictor. Figure 1.3 applies to the combined GT and MATC-Suitability as the predictor ($R^2 = .138$). R^2 (variance overlap) is shown on each graph and is the proportion of the Performance Score that is accounted for by the predictor. The square root of this value is the correlation. As a note for each graph, the performance score was reverse coded so that the true relationship of less time to 7257 qualify being associated with higher predictor scores could be displayed as positive.



Note.

1. Performance score is reverse coded.

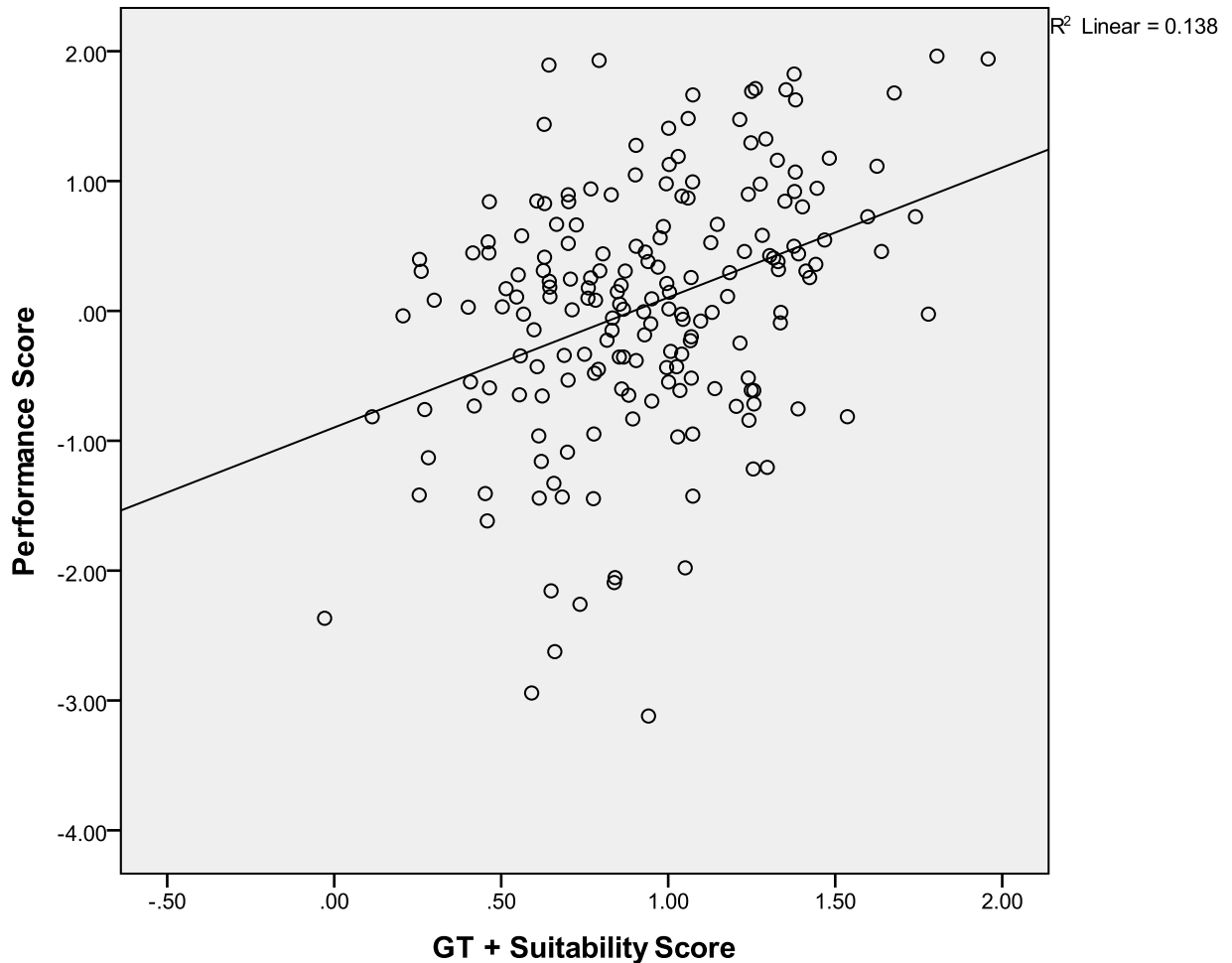
Figure 1. GT Score and Performance Score



Note.

1. Performance score is reverse coded.

Figure 2. MATC-Suitability Test Score and Performance Score



Note.

1. Performance score is reverse coded.

Figure 3. GT Score and MATC-Suitability Test Score Composite and Performance Score

Together, GT Score and MATC- Suitability Test Score account for 13.8% of the variance in performance score whereas MATC-Suitability alone accounts for a slightly greater 14.1%. The “variance accounted for” metric interpretation of a correlation provides meaningful insights into the value of a selection & classification instrument. That is, predictor test developers strive for 100% performance variability accounted for by the predictor (a correlation of 1.0). However, to set a cutscore for an operational selection standard, the correlation coefficient (validity coefficient) is required. The cutscore topic will be fully explained after the data from the next cohort going through the ATC schoolhouse can be analyzed.

At the time of this report attrition outcomes were not present in the ATC operating forces data. Some additional regression analysis was completed adding three NCAPS components: Self-Control (-), Perceptiveness/Depth of Thought (+), and Willingness to

Learn (+). Although, when these three dimensions were combined with the previous four dimensions, the seven trait score was still a significant predictor of Performance Score ($\beta=.390$, $t=6.068$, $p<.000$, $R^2=.152$); any recommendations using this combination will need a larger data set and predictive validity gained from the ATC Schoolhouse population.

The MATC-ST has been shown to be predictive of success for Marine ATCs in the operating forces. Success is determined by time to qualify, therefore the higher the MATC-ST score the less time it took for an operating forces ATC Marine to qualify as a 7257. The expectation is that the relationship will hold up for future ATC Marines and that a near term goal would be to evaluate the positive effects of an operational cutscore.

Recommendations

The Marine ATC Suitability Test (MATC-ST) score is a valid algorithm derived from dimensions of NCAPS. At the time of this report the MATC-ST is shown to be predictive of success for Marine ATCs in the operating forces in a concurrent validity design. Further data collection and analysis at the ATC Schoolhouse will provide confirmation of the MATC-ST's predictive validity, both for training performance and further out to 7257 qualification. It is best practice to combine concurrent validity with predictive validity from the ATC Schoolhouse in order to recommend any conservative cutscores and/or implementation into the Marine Corps Air Traffic Control selection and classification process. Upon completion of the ATC Schoolhouse data analysis, adjustments may or may not be made to the MATC-ST equation. Subsequently, NPRST and the Marine Corps will be in a position to assess an operational cutscores.

If the MATC-ST is to be utilized for selection/classification it is recommended that it be used only in addition to the ASVAB, and implemented at the Military Entrance Processing Station (MEPS) prior to a Marine ATC MOS designation/assignment. This will reduce attrition and increase the quality of Marines selected for the ATC MOS.

In addition to the MATC-ST, an interest measurement tool can also be designed to be implemented at the MEPS to give a more accurate depiction of the ATC field. During this study, some Marines commented that as a recruit they were told to select ATC, but then later they could get the job they really wanted in the Marines if they failed out of school. This is not an accurate depiction of the MOS reassignment process and leads to a disconnection for Marine Corps students. It is recommended that a protocol for Recruiters is established when screening recruits for ATC that includes an interest measure. One tool that the Navy uses in re-classifying is the Jobs and Occupational Interests in the Navy (JOIN). This is an operational computerized interest inventory developed by the Navy for gauging Sailor interest at the time of reclassification. A similar measure can be designed for Marine Corps Air Traffic Controllers for gauging a Marine's interest at the time of enlistment or reclassification.

Limitations

The length of this study was approximately one year. Due to the time constraints there were some limitations in data collection for this study. Although, NCAPS allowed for maximum participation among Marine Air Traffic Controllers in the operating forces because it was web enabled, the performance data collection was not as abundant. It was necessary for an adequate amount of time to pass to collect performance data from the ATC operating forces and ATC Schoolhouse.

There were nine different MATCFs included in this study and each one was visited (with the exception of Futenma and Iwakuni because they were in Japan). The performance measurement records varied by each MATCF. Time to qualify as a performance criterion was collected for 7257, 7252, and 7253/54 using start date and qualification date. However, the start dates for senior ATCs often did not coincide with 7257 qualification dates, and there was not enough data collected for 7252 and 7253/54 qualifications. The bulk of the 7257 time to qualification data came from the ranks of E-6 and below. There were also limitations in the 7257 GPA quantity of data collection from the operating forces because not every MATCF maintained 7257 qualification test scores (i.e. Cherry Point).

Perhaps the biggest limitation at the time of this report is that the ATC Schoolhouse data collection and analysis is not complete. NCAPS and performance data collection at the schoolhouse is still in progress. An additional report will need to be produced at the time of the ATC Schoolhouse data analysis completion.

Conclusion

The greatest outcome of this study even if only at the ATC operating forces level is the answer to a long dwelled upon question of: What individual characteristics will predict success in the Air Traffic Control job? Past Marine Corps studies were unable to link revocations in ATC to ASVAB (GT Scores) or other cognitive based measures. This study has revolutionized this field by providing a non-cognitive measurement tool that predicts success in Air Traffic Control.

As with any test, it is important to continue to validate these tools considering changes in curriculum and additions of simulation based training in order to see if the ASVAB composites and MATC-ST cutscores are adequate for producing a job ready Marine.

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